

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 199964352 B2**
(10) Patent No. **761094**

(54) Title
Intelligent electrical devices

(51)⁶ International Patent Classification(s)
H05B 041/00

(21) Application No: 199964352

(22) Application Date: 1999 . 10 . 08

(87) WIPO No: WO00/22890

(30) Priority Data

(31) Number	(32) Date	(33) Country
09/169395	1998 . 10 . 09	US

(43) Publication Date : 2000 . 05 . 01

(43) Publication Journal Date : 2000 . 06 . 22

(44) Accepted Journal Date : 2003 . 05 . 29

(71) Applicant(s)
Azoteq (Pty) Limited

(72) Inventor(s)
Frederick Johannes Bruwer

(74) Agent/Attorney
GRIFFITH HACK, GPO Box 1285K, MELBOURNE VIC 3001


(56) Related Art
US 5114376
US 4483605
US 5005004



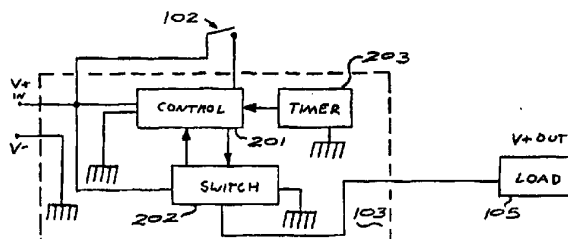
PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H05B 41/00		A2	(11) International Publication Number: WO 00/22890
			(43) International Publication Date: 20 April 2000 (20.04.00)
(21) International Application Number: PCT/ZA99/00107		(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 8 October 1999 (08.10.99)			
(30) Priority Data: 09/169,395 9 October 1998 (09.10.98) US			
(72) Applicant and Inventor: BRUWER, Frederick, Johannes [ZA/ZA]; Unit 2, Lifestyle Management Park, 0157 Lyttelton (ZA).			
(74) Agent: McCALLUM RADEMEYER & FREIMOND; P.O. Box 1130, 2125 Randburg (ZA).			
(71) AZOTEC (PTY) LIMITED 109 Main Street Pretoria 0001 (ZA)		Published Without international search report and to be republished upon receipt of that report. 	

(54) Title: INTELLIGENT ELECTRICAL DEVICES



(57) Abstract

The present invention provides for a unique microchip or circuit which can, *inter alia*, handle both current conducting functions and man-machine-interface functions in an electrical device, for example, such as a flashlight. The man-machine-interface functions, according to the present invention, may be controlled by very low current signals, touch pads, carbon coated membrane type switches, or other low current type switches. These low current switches are smaller, more reliable, less costly, easier to seal, and less vulnerable to corrosion and oxidation than prior art switches. Moreover, since according to the present invention, the current conducting switch is controlled in an intelligent manner by the same microchip which provides the man-machine-interface functioning, significant costs savings and reliability are achieved by the invention. The present invention, according to one embodiment, also provides a microchip or circuit which may be embedded into a power source, for example, a battery, that supplies intelligence to the same. As a result, and according to the invention, functions such as delayed switching, dimming, delayed automatic shut off and an intermittent activation may be realized in less intelligent prior art electrical devices. According to certain embodiments of the present invention, the inventive microchips or circuits of the present invention can, *inter alia*, adjust the average electrical current through a current switch, provide an "on" and "off" sequence which, in the case of a flashlight, can be determined by an operator and may represent either a flash code sequence or a simple on-off oscillation, delayed shut off function, dimming function, provide indication of power strength, and provide gradual oscillating current flow to lengthen the life of the operating switch and the battery, etc. The function can be selected by varying the time period which elapses between successive activations of a controlling switch.

INTELLIGENT ELECTRICAL DEVICES

FIELD OF THE INVENTION

The present invention relates to new intelligent electrical current switching devices and more particularly, to microchip controlled electrical current switching devices. The invention further relates, in one embodiment, to intelligent batteries having embedded therein a microchip for use with a variety of electrical devices to add heretofore unknown functionality to existing electrical devices. The invention also relates, according to another embodiment, to intelligent hand-held electronic devices, and in a preferred embodiment to hand-held light sources, and more particularly, to flashlights.

10 According to one embodiment of the present invention, the invention relates to intelligent hand-held flashlights having microchip controlled switches wherein said switches can be programmed to perform a variety of functions including, for example, turning the flashlight off after a pre-determined time interval, blinking, or dimming, etc. According to a still further embodiment, the invention relates to low current switches controlled by

15 microchips of the present invention for use in building lighting systems.

BACKGROUND OF THE INVENTION

In conventional flashlights, manually-operated mechanical switches function to turn the flashlight "on" and "off." When turned "on," battery power is applied through the closed switch to a light bulb, the amount of power then consumed depends on how long the switch is closed. In the typical flashlight, the effective life of the battery is only a few hours at most. Should the operator, after using the flashlight to find his/her way in the dark or for any other purpose, then fail to turn it off, the batteries will, in a very short time, become exhausted. Should the flashlight be left in a turned-on and

20 exhausted condition for a prolonged period, the batteries may then leak and exude corrosive electrolyte that is damaging to the contact which engages the battery terminal as well as the casing of the flashlight.

When the flashlight is designed for use by a young child the likelihood is greater that the flashlight will be mishandled, because a young child is prone to be careless and

30 forgets to turn the flashlight "off" after it has served its purpose. Because of this, a flashlight may be left "on" for days, if not weeks, and as a result of internal corrosion may no longer be in working order when the exhausted batteries are replaced.

Flashlights designed for young children are sometimes in a lantern format, with a casing made of strong plastic material that is virtually unbreakable, the light bulb being mounted within a reflector at the front end of the casing and being covered by a lens from which a light beam is projected. A U-shaped handle is attached to the upper end of the casing, with mechanical on-off slide switch being mounted on the handle, so that

5 a child grasping the handle can readily manipulate the slide actuator with his/her thumb. With a switch of this type on top of a flashlight handle, when the slide actuator is pushed forward by the thumb, the switch "mechanically" closes the circuit and the flashlight is turned "on" and remains "on" until the slide actuator is pulled back to the

10 "off" position and the circuit is opened. It is this type of switch in the hands of a child that is most likely to be inadvertently left "on."

To avoid this problem, many flashlights include, in addition to a slide switch, a push button switch which keeps the flashlight turned on only when finger pressure is applied to the push button. It is difficult for a young child who wishes, say to illuminate a dark corner in the basement of his home for about 30 seconds, to keep a push

15 button depressed for this period. It is therefore more likely that the child will actuate the slide switch to its permanently-on position, for this requires only a monetary finger motion.

It is known to provide a flashlight with a delayed action switch which automatically turns off after a pre-determined interval. The Mallory U.S. Patent No. 3,535,282 discloses a flashlight that is automatically turned off by a delayed action mechanical switch assembly that includes a compression spring housed in a bellows having a leaky valve, so that when a switch is turned on manually, this action serves to mechanically compress the bellows which after a pre-determined interval acts to turn off

20 the switch.

A similar delayed action is obtained in a flashlight for children marketed by Play-skool Company, this delayed action being realized by a resistance-capacitance timing network which applies a bias to a solid-state transistor switch after 30 seconds or so to cut off the transistor and shut off the flashlight. Also included in the prior art, is a

25 flashlight previously sold by Fisher-Price using an electronic timing circuit to simply turn off the flashlight after about 20 minutes.

It is also known, *e.g.* as disclosed in U.S. Patent No. 4,875,147, to provide a mechanical switch assembly for a flashlight which includes a suction cup as a delayed action element whereby the flashlight, when momentarily actuated by an operator, functions to connect a battery power supply to a light bulb, and which maintains this
5 connection for a pre-determined interval determined by the memory characteristics of the suction cup, after which the connection is automatically broken.

U.S. Patent No. 5,138,538 discloses a flashlight having the usual components of a battery, and on-off mechanical switch, a bulb, and a hand-held housing, to which there is added a timing means and a circuit-breaking means responsive to the timing means
10 for cutting off the flow of current to the bulb, which further has a by-pass means, preferably child-proof, to direct electric current to the light bulb regardless of the state of the timing means. The patent also provides for the operation of the device may be further enhanced by making the by-pass means a mechanical switch connected so as to leave it in series with the mechanical on-off switch. Furthermore, the patent discloses
15 a lock or other "child-proofing" mechanism may be provided to ensure that the by-pass is disabled when the flashlight is switched off.

Most conventional flashlights, like those described above, are actuated by mechanical push or slide button-type switches requiring, of course, mechanical implementation by an operator. Over time, the switch suffers "wear and tear" which impairs
20 operation of the flashlight as a result of, for example, repeated activations by the operator and/or due to the fact that the switch has been left "on" for a prolonged period of time. In addition, such mechanical switches are vulnerable to the effects of corrosion and oxidation and can cause said switches to deteriorate and to become non-functioning. In addition, these prior art devices having these mechanical switches are
25 generally "dumb," *i.e.* they do not provide the user with convenient, reliable, and affordable functionalities which today's consumers now demand and expect.

The prior art switches typically provide two basic functions in prior art flashlights. First, the mechanical switches act as actual conductors for completing power circuits and providing current during operation of the devices. Depending upon the type
30 of bulb and wiring employed, the intensity of electrical current which must be conducted by the switch is generally quite high leading to, after prolonged use, failure. Second,

these mechanical switches must function as an interface between the device and its operator, i.e. the man-machine-interface ("MMI") and necessarily requires repeated mechanical activations of the switch which over time
5 mechanically deteriorate.

Also, currently the electrical switches used in buildings/houses for control of lighting systems are of the conventional type of switches which must conduct, i.e. close the circuit, upon command, thus also providing the
10 MMI. These prior art switches suffer from the same disadvantages as the switches described above in relation to portable electronic devices, like flashlights. Moreover, the switches are relatively dumb in most cases and do not provide the user with a variety of functions,
15 e.g. but not limited to timing means to enable a user, for example, a shop owner or home owner, to designate a predetermined shut off or turn on point in time.

There is a need for inexpensive, reliable, and simple intelligent electronic devices which provide
20 increased functionality and energy conservation.

SUMMARY OF THE INVENTION

The present invention provides an electrical device for use with a circuit which has an exhaustible
25 power source and an energy consuming load which is powered by the power source, said device including at least a man-machine-interface (MMI) signal switch, which is not a serial part of an energy transfer circuit from the power source to the load, a microchip which is in communication
30 with the signal switch and a power switch and which controls the power switch for connecting the power source to, and disconnecting the power source from the load, and an energy storage device that is used to power said microchip when said power switch is conducting power to
35 said load, said energy storage device being charged only when said power switch is not conducting energy to said load, and wherein said device is operable with only two

connections to said circuit.

The invention also provides an electrical device for use with a circuit which has an exhaustible power source and an energy consuming load which is powered by the power source, said device including at least a man-machine-interface (MMI) signal switch, which is not a serial part of an energy transfer circuit from the power source to the load, a microchip which is in communication with the signal switch and a power switch and which controls the power switch for connecting the power source to, and disconnecting the power source from, the load, and function means for providing at least two functions selected from the following:

- (a) activating a find-in-the-dark indicator, when said load is not energised and said power source is not being charged;
- (b) activating a power source level indicator, also when the load is not activated and the power source is not being charged;
- (c) charging an energy storage device from the said power source when the power switch is not conducting and using said energy storage device to power the microchip when the power switch is conducting energy from the power source to the load; and
- (d) a delayed shut-off function of the power from the power source to the load in response to an activation command; and
- (e) a function of adjusting the average power from the power source to the load, in response to at least one input actuation.

The invention still further provides an electrical device for use in a circuit with a non-exhaustable power source being a mains power source (AC) and an energy consuming load, said device including a man-machine-interface signal switch which is operated with DC power and connected to a signal input on a microchip, said signal switch and input not forming a serial part of an

energy transfer circuit from said power source to said load, and a power switch, controlled by said microchip, wherein said power switch controls the connecting and disconnecting of power to said load, and wherein

5 connecting conducting lines between said signal switch and said microchip are inherently safe to humans, and low energy connections including one set of means selected from the following group:

10 the connecting conducting lines between said signal switch and said microchip are embedded in a stickable tape which can be attached to a surface; and

the connecting conducting lines between said signal switch and said microchip are formed by drawing lines on a surface with conductive paint or ink.

5 While the present invention is primarily described in this application with respect to either a flashlight or a battery therefore, the embodiments discussed herein should not be considered limitative of the invention, and many other variations of the use of the intelligent devices of the present invention will be obvious to one of ordinary skill in the art.

10

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic of a device having a microchip controlled push button or sliding type input activation/deactivation switch according to one embodiment of the present invention;



15

Figure 2 is a block diagram of a microchip for use in association with a push button or sliding input activation/deactivation switch according to one embodiment of the invention;



20

Figure 3 is a schematic of a second type of intelligent device having a microchip controlled push button or sliding type input activation/deactivation switch according to another embodiment of the invention;



25

Figure 4 is a schematic of a device having a microchip controlled touch pad or carbon coated membrane activation/deactivation switch according to a still further embodiment of the invention;

Figure 5 is a block diagram of a microchip for use in association with a touch pad or carbon coated membrane activation/deactivation switch according to one embodiment of the invention;

Figure 6 is a schematic of a second type of device having a microchip controlled touch pad or carbon coated membrane activation/deactivation switch according to one embodiment of the invention;

30 Figure 7 is a schematic of a battery having embedded therein a microchip according to a further embodiment of the invention;

Figure 8A is a block diagram of a microchip for use in a battery according to one embodiment of the present invention;

Figure 8B is a block diagram of a second type of microchip for use in a battery according to another embodiment of the present invention;

5 Figure 9 is a schematic of a device having a microchip controlled switch according to one embodiment of the invention;

Figure 10 is a schematic of a device having a microchip controlled switch according to one embodiment of the invention;

10 Figure 11 is a schematic of a device having a microchip controlled switch according to one embodiment of the present invention;

Figure 12 is a schematic of a flashlight having therein a microchip controlled switch according to one embodiment of the present invention;

Figure 13 illustrates a possible position, according to one embodiment of the present invention of a microchip in a battery;

15 Figure 14 is a schematic of one embodiment of the present invention of a low current switching device suitable for lighting systems in buildings;

Figure 15 is a block diagram of one embodiment of the present invention, *i.e.* microchip 1403 of Figure 14;

20 Figure 16 is a flow diagram for a microchip as shown in Figures 4 and 5 for a delayed shut off function embodiment of one embodiment of the present invention; and

Figure 17 is a flow diagram for a microchip as shown in Figures 7 and 8a for a delayed shut off function embodiment of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

25 According to one embodiment or aspect of the present invention, and referring to Figure 1, a schematic depiction of main circuit 100 of an electronic device, for example, a flashlight, is provided, wherein the device has a microchip 103 and a microchip controlled input activator/deactivator 102, for example, a push button or sliding switch. Main circuit 100 of the device is powered by a current supplied by
30 power source 101. Power source 101 may be any power source, *e.g.* a DC battery, as is well known to those of ordinary skill in the art. While the following discussion is

limited to specific electronic devices, that is flashlights, it is to be understood that the following description is equally applicable to other electronic devices including portable radios, toys, for example but not limited to battery operated cars, boats, planes, and/or other electrically powered toys.

5 Referring to Figure 1, when an operator activates input push button or sliding command switch 102 to the "on" position, the microchip 103 receives a signal. Switch 102 is a direct electrical input to microchip 103. Microchip 103 is grounded by grounding means 104. Microchip 103 is in series between power source 101 and load 105. Microchip 103 also transfers sufficient power through means of a current switch
10 (not shown in Figure 1) to load 105 which can be, for example, a resistor-type bulb in the case of a flashlight to provide illumination.

The microchip 103, and other microchips of the present invention, can have its/their intelligence embedded in combinational or sequential logic, a PLA or ROM type structure feeding into a state machine or a true microcontroller type structure. The
15 memory for the above will normally be non-volatile, but should there be a need for selectable options, EE or flash memory structures may be used.

The structure and operational parameters of such a microchip 103 are explained in greater detail below with respect to Figure 2. As shown in Figure 1, power is supplied to microchip 103 by power source 101. When an operator activates input
20 switch 102 to the "on" position it represents a command which is communicated to microchip 103. Input means 102 requires very low current in preferred embodiments. In one embodiment of the invention, microchip control/reset means 201 simply allows the current switch 202 to pass current provided from power source 101 to load 105 in an unimpeded manner when the MMI switch 102 is activated, and, in the case of a
25 flashlight, illumination is obtained. It is important to recognize, however, that it is control circuit 201 which activates current switch 202 upon acting on an input from MMI switch 102. Unlike heretofore known prior art devices, activating switch 102 does not conduct current to load 105, but is only a command input mechanism which can, according to the invention, operate on very low current. For example, according
30 to the invention, touch sensor input or carbon coated membrane type switch devices are preferred.

If, for example, an emergency notification function is desired, the flashlight may be designed to alternately flash on and off every second. First, the operator activates input 102 into the appropriate position to indicate such a function is desired. During the "on" segment of the flashing routine, control/reset means 201 commands current switch 202 to close and let current flow through to load 105, thereby causing, in the case of a flashlight, the bulb to illuminate. Simultaneously, control/reset means 201 uses the timing means 203 as a clock for timing. After control/reset means 201 determines one second has elapsed, control/reset means 201 instructs current switch 202 to open and interrupt the current flow through to load 105, and bulb illumination is discontinued. It is important to note that both control/reset means 201 and current switch 202 are still active and fully powered; however, current delivery is now latent with respect to load 105. When another second has elapsed, a command is passed from control/reset means 201 which again allows current to be delivered through current switch 202 to load 105, and in the case of a flashlight, bulb illumination is immediately resumed. The device continues an alternating current delivery routine until either the operator switches the setting of the activating input switch 102 to the "off" position, or until the conditions pre-programmed into the microchip, *e.g.* into the control/reset means 201, are satisfied and current delivery is permanently discontinued.

Similar operating routines can be employed to generate other conspicuous flashing functions such as the generation of the universal distress signal S.O.S. in Morse code. Again, such a function would require that the microchip, *e.g.* control/reset means 201, be pre-programmed with the appropriate code for creating such a signal, and to permit current transmission from switch 202 to load 105 in accordance with the code with the assistance of timing means 203. For example, it may be desirable to have an S.O.S. sequence wherein flashes representing each individual letter are separated by time intervals ranging from one-half (1/2) second to one (1) full second, while the interval between each letter in the code comprises two (2) full seconds. After a certain number of repetitions of the routine, again determined by the operator or as pre-programmed within the microchip, *e.g.* within the control/reset means 201, the signal is discontinued.

As shown in Figure 3, it is possible to remove grounding means 104 from main circuit 100. However, it is then necessary to intermittently provide an alternative power

source for microchip 103 and to create a virtual ground reference level. A suitable microchip 103 for this configuration is described in greater detail below with respect to Figures 8A and 8B.

Referring now to Figure 4, utilizing the circuits in the microchip of some
5 embodiments of the present invention, carbon coated membrane or touch pad type switches are preferred. Carbon coated membrane switches and touch pad switches have many advantages over conventional high current switches, such as those currently used in flashlights. According to the present invention, carbon coated membrane type
10 switches, low current type switches, and touch pad type switches can be used which may be smaller, less costly, easier to seal, and less vulnerable to corrosion and oxidation than conventional switches which also transfer energy or current to the load. Moreover, according to one embodiment of the present invention, carbon coated membrane type switches, touch pad switches, or low current type switches can be formed structurally
15 integral with the product, for example, with the casing of a flashlight.

A block diagram showing microchip 103 for use, in accordance with one
embodiment of the present invention, in association with a carbon coated membrane, a
touch pad switch, or a low current type switch 106 is now explained in greater detail
in respect to Figure 5. According to this one embodiment of the present invention,
current switch 202 is powered directly by grounded power source 101. However,
20 output of current from current switch 202 to load 105 is dependent on control/reset means 201. When an operator depresses touch pad 106, carbon coated membrane switch 106 or low current type switch 106, control/reset means 201 allows current switch 202 to flow current through to load 105. However, in more intelligent applications according to certain embodiments of the present invention, control/reset means 201
25 will coordinate, based on clock and/or timing means 203, to execute timing routines similar to those described above such as, but not limited to, intermittent flashing, the flashing of a conspicuous pattern such as Morse code, dimming functions, battery maintenance, battery strength/level, etc.

Figure 16 is a flow diagram for a microchip 103 as shown in Figures 4 and 5
30 and provides a delayed shutoff function. The flow sequence commences at START when the power source 101 is connected to the microchip 103, as shown in Figure 4. The

sequence of operation is substantially self-explanatory and is not further elaborated herein.

As shown in Figure 6, grounding means 104 can be removed from the system as a matter of design choice. A more detailed description of a suitable microchip 103 for this type of configuration is provided below with respect to Figures 8A and 8B.

Referring to Figure 7, certain embodiments of the present invention also provide for a battery having a microchip embedded for use in association with an electronic device. As shown, direct current is provided to microchip 103 by power source 101. When activating input switch 102 is closed, current is complete and power is transferred to load 105 at the direction of microchip 103. Microchip 103 embedded in the battery can have any number of intelligent functions pre-programmed therein, such as, for example but not limited to, battery strength monitoring, recharging, adjustment of average current through a current switch, intermittent power delivery sequences, and so on. Examples of suitable microchips 103 for this type of application are discussed below with reference to Figures 8A and 8B.

Figures 8A and 8B are block diagrams of two different further embodiments of the present invention. Microchip 803 is especially suitable for applications wherein microchip 803 is not grounded through the body of the electrical device or where a ground cannot otherwise be established because of design considerations. This embodiment is useful to provide sufficient operating power to the microchip and can be achieved by periodically opening and closing current switch 202 when activation input switch 102 is closed. For example, referring to Figure 8A, when input switch 102 is closed but current switch 202 does not conduct (that is, the switch is open and does not allow current to flow to load 105), then voltage drop over load 105 is zero and in the case of a flashlight, no illumination is provided from the bulb. Instead, the full voltage drop is over current switch 202 and in parallel with the diode 204 and capacitor 205. Once capacitor 205 becomes fully charged, current switch 202 can close and circuit 103 will be powered by capacitor 205. When circuit 803 is adequately powered, it functions in a manner identical to the circuits described previously with respect to the functions provided by control/reset means 201 and timing means 203.

When the charging capacitor 205 starts to become depleted, control/reset means 201 will recognize this state and reopen the current switch 203, thus briefly prohibiting the flow of current to load 105, in order to remove the voltage drop from load 105 and allow capacitor 205 to recharge and begin a new cycle. In a flashlight application, the time period wherein current flow from current switch 202 is discontinued can be such that the dead period of the light is not easily or not at all detectable by the human eye. In the case of a high current usage load, such as a flashlight, it means the ratio of the capacitance of the capacitor having to power the microchip and the current consumption of the microchip, must be such that the capacitor can power the microchip for a long time relative to the charging time (202 open). This will enable the flashlight's "off" time to be short and the "on" time to be long, thus not creating a detectable or intrusive switching of the flashlight to the user.

Figure 17 is a flow diagram for a microchip as shown in Figures 7 and 8 which also provides a delayed shutoff function. The flow diagram is substantially self-explanatory and the flow sequence commences at START when closure of the switch 102 takes place from an open position.

According to another embodiment of the present invention, *e.g.* in relation to another product of low current consumption, such as a FM radio, the designer may opt for a capacitive (reservoir) device externally to the microchip (see FIG. 11). In this case, the electrical device may function for a time longer than the time required for charging the capacitor (205, 207) which is when the current switch (202) is open and not conducting current.

According to another embodiment of the present invention, an output may be provided to indicate a condition, *e.g.* a battery is in good or bad condition. It may also be suitable to assist in locating a device, *e.g.* but not limited to a flashlight, in the dark. This may be a separate output pin or may be, according to another embodiment, shared with the MMI switch input. (See FIG. 11) This output or indicator may be a LED. Referring to Figure 11, indicator/output device 1104 may, for example, be an LED. When microchip 1113 pulls the line 1114 to high, the LED 1104 shines. LED 1104 may also shine when switch 1111 is closed by the user. However, since that is only a momentary closure, this should not create a problem.

According to a further specific embodiment of the invention, referring to Figure 11, microchip 1113 can activate the LED 1104 for a short time, *e.g.* every 100 milliseconds, every 10 seconds. This indication will let potential users know the device is in a good state of functionality and will enable fast location of the device in the dark, *e.g.* in times of emergency. The low duty cycle will also prevent unnecessary battery depletion. With an alternative embodiment of the present invention, Figure 8B illustrates the charging and discharging of capacitor 207 to provide power to circuit 803, wherein the diode and capacitor structure establishes a ground reference for circuit 803.

Each of the embodiments explained with respect to Figures 8A and 8B are suitable for use, according to the present invention, depending upon the application. Indeed, the embodiments shown in Figures 8A and 8B can be directly embedded into a battery and/or can be separately constructed in another portable structure, *e.g.* but not limited to, in the shape of a disc, about the size of a quarter, to be inserted at the end of the battery between the output means or positive terminal of the battery and the current receiving structure of the electronic device. As described, the embodiments shown in Figures 8A and 8B can be utilized with the prior art high current switches currently being utilized in simple non-intelligent electronic devices, for example flashlights, radios and toys. For example, in the case of a portable simple radio without any intelligence, an automatic shut "off" may be achieved by using the intelligent battery or portable microchip of the present invention having a timing function to automatically shut off the radio after a given period of time, *i.e.* after the user is asleep.

The architecture of the two embodiments of the present invention shown in Figures 8A and 8B provide certain advantages over the simple dumb architecture in current simple electrical devices, for example, flashlights. Due to the unique design of the microchips, as shown in Figures 8A and 8B, after the device (into which the microchip is incorporated) is shut off the microchip remains powered for an additional period of time which allows for said microchip to thus receive additional commands, for example, a second "on" activation within a given period after a first "on" and "off" activation, may be programmed into the microchip (control/reset means) to indicate a power reduction or dimming function or any other function as desired by the designer

of said device. This is accomplished by the inventive designs of the present invention without having to utilize substantial energy from what are typically small exhaustible power sources, *e.g.* DC batteries in the case of flashlights.

According to some embodiments of the present invention, more intelligent devices
5 include many other useful functions pre-programmed within the microchip, *e.g.* in control/reset means 201 and may, *e.g.* be assisted by a timing means 203. Referring to Figure 2, commands can be entered through switch 102 in several different ways. First, various time sequences of closed and open activations may represent different commands. For example, but not limited to, a single closure may instruct microchip 103 to
10 activate current switch 202 continuously for a pre-determined length of time. Alternatively, two successive closures may instruct the microchip 103 to intermittently activate current switch 202 for a pre-determined length of time and sequence, for example, a S.O.S. sequence.

Secondly, referring to Figure 9, commands may be communicated to microchip
15 903 through the use of various voltages recognizable by microchip 903 to represent various commands. For example, but not limited to, according to one embodiment of the present invention, it may include multiple activating switches 901 and 902 connecting different voltages to the command input structure of microchip 903.

Thirdly, referring to Figure 10, commands may be communicated to microchip
20 1003 through the use of multiple specific switches (1004, 1005, 1006, 1007) which when activated either singularly or in combination is/are recognizable by microchip 1003 as representing various different commands.

As can be seen by Figure 9, switch 901 and 902 and in Figure 10, switches
1004, 1005, 1006, and 1007, power or ground may be used as a command reference
25 voltage level. For example, the switches in Figure 10 may be connected to another ground instead of point 1008 depending on the internal structure of the microchip.

The control/reset means included in the inventive microchips of the present invention may and in some instances, depending upon the application, should in addition to the many possible user functions described above, include means for adjusting the
30 average current over a switch and/or a means for providing a gradual "on"/"off" current flow, so that the operator does not appreciably perceive the increase and decrease in

light provided by the device. These features allow for an ongoing variable level of lighting as desired by an operator, and may also lengthen the life span of the activation switch, the bulb, and the power source. Moreover, several functions can now be added to an existing device, like a flashlight, through the use of a battery having embedded
5 therein a microchip according to the present invention.

In another embodiment of the invention, the microchip is adapted to control lighting in buildings. The normal switch on the wall that currently functions as both a power-switch and MMI can be replaced by a low current switching device like a membrane switch, touch pad or carbon coated switching device. Since very low currents are
10 required by the MMI switch (device) that replaces the normal wall mounted (A/C) switch, it is possible to replace the normal high voltage/current (dangerous) wiring to the switch and from the switch to the load (light), with connectivity means suitable to the new low current DC requirements. As such, in the case of normal A/C wiring (110V/220V), the dangerous wiring can now be restricted to the roof or ceiling and all
15 switches (MMI's) can inherently be safe. This may make the expensive and regulated safety piping required for the wiring of electricity to wall switches redundant.

In a specific embodiment, the traditional wiring between the light and the wall switch is replaced by flexible current conducting tape that can be taped from the roof and down the wall to the required location. In another embodiment, the connections
20 can be made by current conducting paint or similar substances. In both cases above, it can be painted over with normal paint to conceal it. This makes changing the location of a wall switch or the addition of another switch very easy.

The microchip according to the present invention can be located in the power fitting of the light. The microchip having the low current (MMI) input and a power
25 switch to block or transfer the energy to the load (light, fan, air conditioner). It reacts to the inputs received to activate or disable, or control other functions, of whatever device it is controlling.

The microchip may be adapted to contain the high current/voltage switch or control an external switching device or relay. The microchip may also, as in the other
30 embodiments discussed, have some intelligence to control functions like dimming, delayed shut off, timed activation/deactivation, timed cycles, flashing sequences and

gradual on/off switching. The microchip may also be adopted, as in a specific flashlight embodiment discussed, to provide a location/emergency signal for lighting/flashing an LED.

Figure 12 shows a flashlight 1200 with a housing 1202, batteries 1204, a bulb 1206, a reflector and lens 1208, a switch 1210 and a microchip 1212. The flashlight has a conventional appearance but its operation is based on the microchip 1212 controlling the operation of the switch 1210, as described hereinbefore.

Figure 13 illustrates that a battery 1300 with positive and negative terminals 1302 and 1304 respectively, and of substantially conventional shape and size, can be fabricated with an integral microchip 1306, of the type described hereinbefore. Alternatively the microchip can be mounted to the battery, for example by being inserted into a preformed cavity. As the microchip is inserted into the cavity it makes contact with the positive and negative terminals on the battery. The microchip also carries external terminals so that when the battery is inserted into an appliance (not shown) it makes direct contact with corresponding terminals on the appliance so that the microchip is automatically connected in circuit.

The power input 101 in Figure 14 may be DC (eg 12V) as is commonly used for some lights or A/C (110V or 240V). The device shown as 1403 may be monolithic or be a multichip unit having a relay (solid state or mechanical), a regulator (eg: 110AC volt to 12V DC) and a microchip as discussed in this application.

In a specific embodiment, Ic pin 1406 can normally be high and a closure of input means 1402, e.g. any of the low current switching devices described above, can be detected as Ic pin 1405 also goes too high. To flash the LED 1404 the microchip will reverse the polarities so that Ic pin 1405 becomes high with regards to Ic pin 1406. During this time, it may not be possible to monitor the closure of the input 1402 switch and the LED 1404 may not shine should the input 1402 be closed. In another embodiment, microchip 1403 is able to detect closure of input 1402 before reversing the voltage polarity as discussed and if it detects closure, it does not proceed with reversing the polarity.

Reference 1407 denotes an MMI wall unit, and reference 1408 denotes a high voltage roof unit.

In Figure 15, microchip 1503 does not contain a current switch (eg switch 102) as shown in Figure 2. However, if desired a regulator 1504 and relay 1505 can be integrated into a single monolithic microchip 1503. In case of a 12V (DC) local voltage this may be done in any event unless the current/power considerations are too high to make it practical.

In another embodiment, the microchips 1403 and 1503 are adapted to receive commands not only via the MMI input but also over the load power (electricity) wiring. This would allow a central controller to send out various commands to various power points, controlled by a microchip according to this invention, by using address information of specific microchips or using global (to all) commands.

Referring again to Figure 1, and this is being done purely for the sake of example, the microchip 103 is activated by sliding or activating a switch 102. It is apparent that different switches can be provided for different functions of the microchip. However, in order to enhance the user-friendliness of the device, a single switch may be capable of controlling different functions of an appliance such as a flashlight to which the microchip is mounted.

Assume for the sake of example that the switch 102 is used to turn the microchip on in the sense that a flashlight is turned on. A switch 110 may then be used at any time to turn the flashlight off, by appropriately controlling operation of the microchip. This is a conventional approach to controlling the operation of the microchip. As an alternative the operation of the switch 102 can be sensed by means of a timing device 112. The timing device is started when the switch 102 is closed and after a short time period, say of the order of 5 seconds or less, which is measured by the timing device, the mode or function of the switch 102 changes so that, upon further actuation of the switch 102, the switch duplicates the function of the switch 110 which can therefore be dispensed with. Thus, initially the switch 102 functions as an on-switch while, a short period after its actuation, the switch 102 functions as an off-switch. It follows that with minor modifications to the circuitry of the microchip a single switch can exhibit multi-mode capabilities with the different modes being distinguished from each other or being exhibited on a time basis or, if necessary, on any other basis.

Multimode capabilities can for example be incorporated in a microchip wherein the function of a switch is also linked to time. In this sense the word "function" means the action which ensues or results upon the detection of the closure of the switch. For example a single switch may, from an off state of a flashlight, enable (a) the switching
5 on of the flashlight and (b) the selection of one of a number of various modes like dimming level, flashing rate/sequence etc when the switch is closed a number of times.

If however a certain time is allowed to pass (say five seconds) without any further closure of the switch taking place (indicating a mode has been selected), the function
10 resulting from the next closure may be changed. Thus instead of selecting another mode, the closure may be interpreted as an "off" command.

In other words a sequence of switch closures within five seconds of each other will continue to step the microchip through a number of predefined modes. However should
15 at any stage a time of more than five seconds elapse between consecutive presses or closures of the switch then the next switch operation will switch the flashlight off rather than stepping the microchip to another mode.

Clearly these characteristics are not confined to the use of the chip with a flashlight for
20 the chip can be used with other applications to vary the mode of operation thereof in an analogous way. Thus, for the flashlight, the function of the switch will affect the operation of the flashlight in a manner which is dependent on the time period between successive actuations of the switch. More generally, in any electrical device which is controlled by means of the microchip the operation of the device will be regulated by
25 the function which is exhibited by a switch which is in communication with the microchip. The switch function in turn is dependent on the duration of a time period between successive operations of the switch.

Other modes can also be exhibited by a single switch. For example, depending on
30 requirement, a switch can be used for on and off operation, for initiating the transmis-

sion of an emergency signal, for initiating the gradual dimming of a flashlight or the like. The scope of the invention is not limited in this regard.

While the preferred embodiments of the present invention have been described in detail, it will be appreciated by those of ordinary skill in the art that changes and
5 modifications may be made to said embodiments without, however, departing from the spirit and scope of the present invention as claimed.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An electrical device for use with a circuit which
5 has an exhaustible power source and an energy consuming
load which is powered by the power source, said device
including at least a man-machine-interface (MMI) signal
switch, which is not a serial part of an energy transfer
10 circuit from the power source to the load, a microchip
which is in communication with the signal switch and a
power switch and which controls the power switch for
connecting the power source to, and disconnecting the
power source from the load, and an energy storage device
15 that is used to power said microchip when said power
switch is conducting power to said load, said energy
storage device being charged only when said power switch
is not conducting energy to said load, and wherein said
device is operable with only two connections to said
circuit.
- 20
2. An electrical device for use with a circuit which
has an exhaustible power source and an energy consuming
load which is powered by the power source, said device
including at least a man-machine-interface (MMI) signal
25 switch, which is not a serial part of an energy transfer
circuit from the power source to the load, a microchip
which is in communication with the signal switch and a
power switch and which controls the power switch for
connecting the power source to, and disconnecting the
30 power source from, the load, and function means for
providing at least two functions selected from the
following:
- (a) activating a find-in-the-dark indicator, when
said load is not energised and said power source is not
35 being charged;
- (b) activating a power source level indicator, also
when the load is not activated and the power source is not

being charged;

- (c) charging an energy storage device from the said power source when the power switch is not conducting and using said energy storage device to power the microchip
5 when the power switch is conducting energy from the power source to the load; and
(d) a delayed shut-off function of the power from the power source to the load in response to an activation command; and
10 (e) a function of adjusting the average power from the power source to the load, in response to at least one input actuation.

3. An electrical device according to claim 2 further
15 providing means for activating a find-in-the-dark indicator when the said two functions are selected from 1(b), (c), (d), and (e).

4. An electrical device according to claim 2 further
20 providing means for a power source level indicator when the said two functions are selected from 1(a), (c), (d), and (e).

5. An electrical device according to claim 2 further
25 providing means for adjusting the power to the load when the said two functions are selected from 1(a), (b), (c) and (d).

6. An electrical device according to claim 2 wherein
30 the function means provides a delayed shut-off function, in response to an input signal when the said two functions are selected from 1(a), (b), (c) and (e).

7. An electrical device according to any one of
35 claims 1 to 6, wherein said load is a light generating unit.

8. An electrical device according to any one of claims 1 to 6 wherein said load is an electric motor.

9. An electrical device according to claim 1 or 2 wherein said load is a radio.

10. An electrical device according to any one of claims 2 to 6 wherein the function means additionally provides at least one function selected from the following:

- (a) an oscillating power supplied to the load;
- (b) an intermittent code sequence or flashing function;
- (c) a gradual switching on of the load;
- (d) a gradual switching off of the load.

11. An electrical device according to any one of claims 2 to 6 wherein the function means provides for the controlling of the recharging of said power source function.

12. An electrical device according to any one of claims 2 to 6 wherein the microchip determines one of the functions from the number of successive activation/deactivation signals received from the signal switch and the time between successive actuations of the signal switch.

13. An electrical device according to any one of claims 2 to 6 wherein the signal switch includes more than one input means with each input means indicating a different command function recognisable by the microchip.

14. An electrical device according to any one of claims 2 to 6 wherein the signal switch is a multi-mode switch which, in each mode, controls a different function.

15. An electrical device according to any one of claims 2 to 6 wherein the function selected is dependent on the period of time for which the signal switch is activated, the time period between successive actuations of the signal switch and the number of actuations.

16. An electrical device according to any one of claims 2 to 6 wherein the signal switch is selected from:
(a) a momentary contact type switch, and
(b) a latching type switch.

17. An electrical device according to any one of claims 2 to 6 wherein the microchip recognises that the receipt of different voltages from the signal switch corresponds to different command functions.

18. An electrical device according to any one of claims 2 to 6 wherein the microchip is adapted to receive commands from another controller.

19. An electrical device according to claim 18 wherein said commands include address information which is specific to the microchip.

20. An electrical device according to claim 19 wherein said commands include address information which is specific to the microchip and at least one additional similar microchip.

21. An electrical device according to any one of claims 2 to 6 wherein the find-in-the-dark indicator and the power source level indicator are combined.

22. An electrical device according to any one of claims 2 to 6 wherein the said indicators also indicate a state or condition in response to signals on said input.

23. An electrical device according to any one of claims 2 to 6 wherein the said microchip is not a microprocessor or a microcontroller.

5 24. An electrical device according to any one claims 1 to 22 wherein the microchip includes several discrete components.

10 25. An electrical device according to any one of claims 1 to 24 wherein the energy storage device is a capacitor.

15 26. An electrical device according to any one claims 1 to 25 wherein the microchip monitors the quantity of energy in the energy storage device and causes the power switch to open when the quantity of energy falls below a predetermined level.

20 27. An electrical device according to any one of claims 1 to 25 wherein the microchip causes the power switch to open and close at regular time intervals to cause regular recharging of the energy storage device.

25 Dated this 25th day of March 2003

AZOTEQ (PTY) LTD

By their Patent Attorneys

GRIFFITH HACK

Fellows Institute of Patent and

30 Trade Mark Attorneys of Australia

